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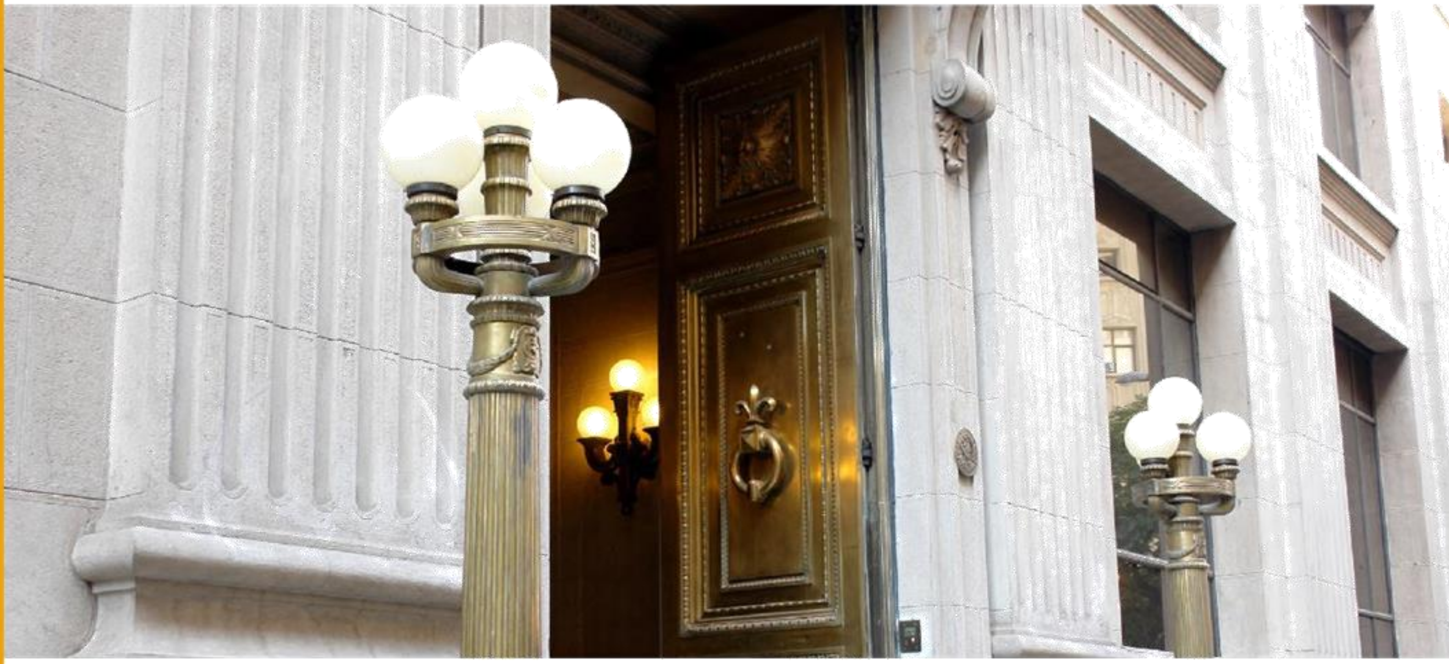

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Saving Constraints, Inequality, and the Credit Market Response to Fiscal Stimulus*

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Abstract

We document substantial heterogeneity in the interest rate response to fiscal stim-ulus (IRRF) across OECD economies. The IRRF is negative in half of the OECD countries, and it declines with income inequality. To interpret this evidence we de-velop a model in which moderately low-income households take on debt to maintain a consumption threshold (saving constraint). Now debt-burdened, these households use additional income to deleverage. In more unequal economies with more saving constrained households, increases in government spending tighten credit conditions less (relax credit conditions more), leading to smaller increases (larger declines) in the interest rate.

Resumen

Usando datos para economías pertenecientes a la OECD, documentamos que la respuesta de la tasa de interés a cambios en gasto de gobierno (IRRF) es heterogénea. El IRRF es negativo en la mitad de los países OECD y es menor en países con mayor desigualdad de ingreso. Para interpretar esta evidencia desarrollamos un modelo en que hogares con relativamente bajo ingreso toman deuda con el objetivo de mantener niveles de consumo mínimo. Estos hogares endeudados usan ingreso adicional para pagar deuda. Por lo tanto, en economías con mayor desigualdad de ingresos, donde hay más hogares endeudados, aumentos en gasto de gobierno generan menor presión en los mercados financieros (generan mayor relajamiento de los mercados financieros), lo cual produce menores aumentos (mayores caídas) en la tasa de interés.

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1 Introduction

The size and length of the Great Recession renewed attention on fiscal policy as a stabilization tool. The design of optimal fiscal policy depends on an understanding of transmission mechanisms. The interest rate response to fiscal stimulus, which we call the IRRF, is of central importance, as it controls the extent to which stimulus crowds out investment and therefore future output.

Despite the relevance of the interest rate channel, the literature has yet to offer clarity on how or why the interest rate responds to government spending. This lack of attention and clarity may be due to an apparent conflict between theory and empirical findings. While standard theory (of both neoclassical and New Keynesian underpinnings) predicts that interest rates rise in response to government spending, studies based on the U.S. and U.K. tend to find a zero or negative effect on interest rates (e.g., Barro (1987) and, more recently, Ramey (2011) and Fisher and Peters (2010)). Related and also puzzling is the evidence that government spending tends to be associated with local currency depreciation rather than appreciation (e.g., Ravn et al. (2012), Corsetti et al. (2012a), Faccini et al. (2016)).[1]

Much of the existing evidence on the IRRF is based on data from the U.S. and U.K. (see Murphy and Walsh (2020) for a review). In this paper we expand IRRF estimates to other relatively high-income (OECD) countries, and we exploit heterogeneity in the IRRF across countries to inform theory. In particular, we document that a) the IRRF is negative in half of OECD countries, b) inequality is the strongest predictor of the IRRF, and c) the IRRF is *falling* in inequality. Existing theory offers little guidance on the mechanisms that could account for these patterns, and general equilibrium models are generally unable to explain negative IRRFs for longer-term nominal government bond yields.

Our analysis focuses on government bond yields to capture financial market conditions rather than the stance of monetary policy. We use local projection methods as in Jorda (2005) and consider two approaches to identifying fiscal shocks. First, we follow Blanchard and Perotti (2002), who exploit relatively high frequency data and legislative lags to construct government spending innovations that are plausibly exogenous to current economic conditions. Second, we use the approach proposed by Auerbach and Gorodnichenko (2013), which, unlike that of Blanchard and Perotti (2002), takes into account the anticipation of government spending plans by using surveys of professional forecasters from OECD databases. Our

[1] The mechanism that would imply currency *appreciation* from government spending (vs. the depreciation seen in the data) is straightforward. Increased government spending crowds out private activity. The interest rate increases to clear the goods market, and higher rates attract foreign capital inflows, which appreciate the currency.

baseline cross-country facts focus on the period before the Global Financial Crisis (GFC), but the results are robust to using data post-GFC.

To shed light on the mechanisms responsible for cross-country variation in the IRRF, we regress the IRRFs on country-level characteristics. We document that country-level income inequality is the strongest predictor of the IRRF. In particular, higher inequality is associated with a lower IRRF, both unconditionally and conditional on other potential country-level determinants of the IRRF. Our evidence is surprising given that one might expect high inequality to imply the existence of many credit-constrained households with high marginal propensities to consume (see, for example, Huggett (1993), Aiyagari (1994), and Brinca et al. (2016)) that would, all else equal, push up the IRRF. The negative relationship between inequality and the IRRF suggests new theory is needed to understand the data.

To rationalize this evidence we propose a model with two key features. First, the economy exhibits the potential for slack, implying that government spending does not fully crowd out private-sector activity, which permits a negative IRRF. Second, higher inequality implies that more households use additional income to save (delever). This redistribution generates a negative relationship between the IRRF and inequality.

Our theory generates the first mechanism by building on the notion of minimum consumption thresholds. In a companion paper, Miranda-Pinto et al. (2020), we demonstrate that time-varying minimum consumption thresholds are important for rationalizing many features of the joint dynamics of consumption and income.[2] The stationary equilibrium of a calibrated model yields a large mass of moderately-low-income households for whom consumption is against a minimum threshold. These households use additional income to save. We refer to these households as *saving-constrained*. The model also features very poor credit-constrained households, but their effect on aggregate behavior in response to government transfers is outweighed by the moderately-low-income saving-constrained households.[3]

Here we embed consumption thresholds (saving constraints) in a two-period general equilibrium model to demonstrate that the existence of these moderately-low-income, saving-constrained households can help rationalize our evidence on the relationship between the IRRF and inequality. Our benchmark model abstracts from the existence of the very poor

[2]These stochastic consumption thresholds represent aspects of current consumption that are costly to adjust in the short-term. In particular, we assume that consuming below the threshold yields a utility penalty. For example, the household commits to buy an automobile or take the children to a private school (average threshold) but also commits to cover the implied expenses of unexpected car repairs or school trips (shocks to the threshold). Our model relates to the model of "consumption commitments" in Chetty and Szeidl (2007). In contrast to the symmetric adjustment cost in Chetty and Szeidl (2007), our model displays an asymmetric utility cost of consuming below a threshold. While the threshold is exogenous, households in our model endogenously decide to commit or not to the realized threshold.

[3]The dynamic model in our companion paper features a U-shaped relationship between household income and marginal propensities to consume (MPCs). Our literature review in that paper discusses the mapping of this theoretical prediction to existing evidence on the MPC distribution, including recent papers documenting that MPCs are low (and saving propensities high) for many middle-to-low-income households.

credit-constrained households and assumes the existence of moderately-low-income households and high-income households.[4] The model illustrates in a simple setting how saving constraints generate an inverse relationship between inequality and the IRRF. We assume that, in the first period, the minimum consumption threshold binds for the moderately-low-income households that have access to credit (consistent with the prevalence of saving constraints among moderately low-income households in Miranda-Pinto et al. (2020)). Higher inequality is associated with more moderately-low-income households who must borrow to meet their consumption threshold. Government spending redistributes income to these saving-constrained households with low MPCs.[5] This redistribution to low-MPC households relaxes credit markets and puts downward pressure on the equilibrium interest rate, as government wages help relatively low-income workers delever. With higher inequality, more households are saving-constrained, and government spending relaxes credits market more (tightens them less).

This key implication of consumption thresholds – that rising inequality burdens moderately-low-income households with debt or constrains their saving – has arisen in a number of recent theoretical papers on inequality and finance. Bazillier et al. (2021) survey this literature and provide causal evidence that increases in country-level household credit are driven by increases in income inequality. In particular, the authors show that household credit to GDP increases the most when the redistribution occurs from middle-income households to the rich, consistent with the mechanism in our model.

Our empirical and theoretical results relate to a number of other strands of the literature. Recent empirical work documents determinants of fiscal output multipliers in cross-country settings (e.g., Brinca et al. (2016), Ilzetzki et al. (2013), Corsetti et al. (2012b), Brinca et al. (2021)). While we likewise examine cross-country determinants of the effects of fiscal shocks, our focus is on heterogeneity in interest rates rather than output, and we consider OECD countries exclusively.

Furthermore, our evidence of negative IRRFs in a number of countries potentially helps resolve the puzzling finding of previous papers that expansionary government spending shocks are not clearly associated with exchange rate appreciations (see, for example, Corsetti et al. (2012a)). The standard Mundell-Fleming model predicts that exchange rates should increase as domestic interest rates rise, attracting capital inflows. Evidence against exchange rate appreciation has been interpreted as a rejection of Mundell-Fleming (Ravn et al. (2012)). Our paper offers a potential reconciliation between the data and the Mundell-Fleming interest-

[4]In our Appendix, we develop a model in which the low-income households are credit constrained and show that this model is unable to explain the empirical pattern we document.

[5]Specifically, in producing government goods, the government hires and pays wages to workers, which are comprised of both saving-constrained agents and unconstrained rich agents. Taxes are proportional to income, so wages associated with government production redistribute resources to the saving-constrained households with low MPCs.

rate-channel of exchange rate movements.

The remainder of the paper proceeds as follows. Section 2 documents the relationship between the IRRF and inequality. Section 3 presents a qualitative theory of debt-burdened households to rationalize our findings. Section 4 concludes.

2 The interest rate response to fiscal stimulus

To estimate country-level fiscal shocks and IRRFs, we collect quarterly data on real government consumption, real GDP, and nominal interest rates across countries. Obtaining reliable country-level estimates of fiscal shocks requires a sufficient timespan of data. Therefore we limit our focus to OECD countries, most of which provide quarterly data that span a period of over twenty years. The primary data source is the OECD. We supplement the OECD numbers with data from Haver when the Haver sample extends the OECD sample. A detailed description of the data used to estimate fiscal shocks is in Appendix B.[6]

Our study focuses on government bond yields because they are the interest rate that is the most widely available for our sample. An advantage of examining yields on longer-dated bonds is that they are not directly controlled by central banks but rather depend on credit conditions more generally. Our sample includes all OECD countries for which we observe government bond yields for at least 10 consecutive years prior to the end of our estimation period, 2007. The average maturity in our sample is around 8 years. Our baseline estimation period ends in 2007 in order to avoid structural breaks that may have been associated with the GFC and to focus on the transmission mechanism of government spending shocks outside crisis times. However, the results are robust to using longer time series that include post-GFC data. We also collect data on shorter-term interest rates, which we refer to as policy rates. We use direct measures of central bank policy rates when available. For countries that do not have policy rate data, we use the short-term interest rate series from OECD, IMF, FRED, or Ilzetzki et al. (2013).

2.1 Blanchard and Perotti (2002) shocks

We exploit two alternative approaches to identifying government spending shocks. The first approach is based on Blanchard and Perotti (2002). The key identification assumption is that, within a quarter, government spending is predetermined with respect to other macro variables. Hence government spending responds contemporaneously to its own shock but not to other shocks in the economy. Based on the delay in the political process that typically

[6]The Haver data is in nominal terms. We put the nominal values in real terms by deflating by the country's GDP deflator. Government bond yields are kept as nominal due to lack of data on inflation expectations.

justifies this restriction, much of the literature has adopted the Blanchard-Perotti approach (e.g., Bachmann and Sims (2012), Auerbach and Gorodnichenko (2012), Rossi and Zubairy (2011), Brinca et al. (2016)).

We estimate the interest rate response to fiscal stimulus independently for each country in our sample. To do so we estimate the following local projection specification

$$r_{i,t+h} = \alpha_i + \sum_{l=1}^{L} \psi_{i,h,l} x_{i,t-l} + \beta_{i,h} g_{i,t} + \mu_{i,t+h}, \tag{1}$$

in which $r_{i,t+h}$ is the bond yield of country i at time $t+h$, $g_{i,t}$ is log real government consumption, and $x_{i,t-l}$ is a vector containing lags of the policy rate, log real GDP, log real government consumption, and bond yields. The term $\mu_{i,t+h}$ is the error. We follow Ramey and Zubairy (2018) and normalize government consumption and GDP by trend GDP, which we compute using the HP filter with a smoothing parameter of 1,600.[7] We choose $L = 4$ lags.

We estimate impulse responses of interest rates to the fiscal shocks. Figure 1 shows the response of bond yields to government spending shocks, and its 90% confidence interval, for Finland and the USA.[8]

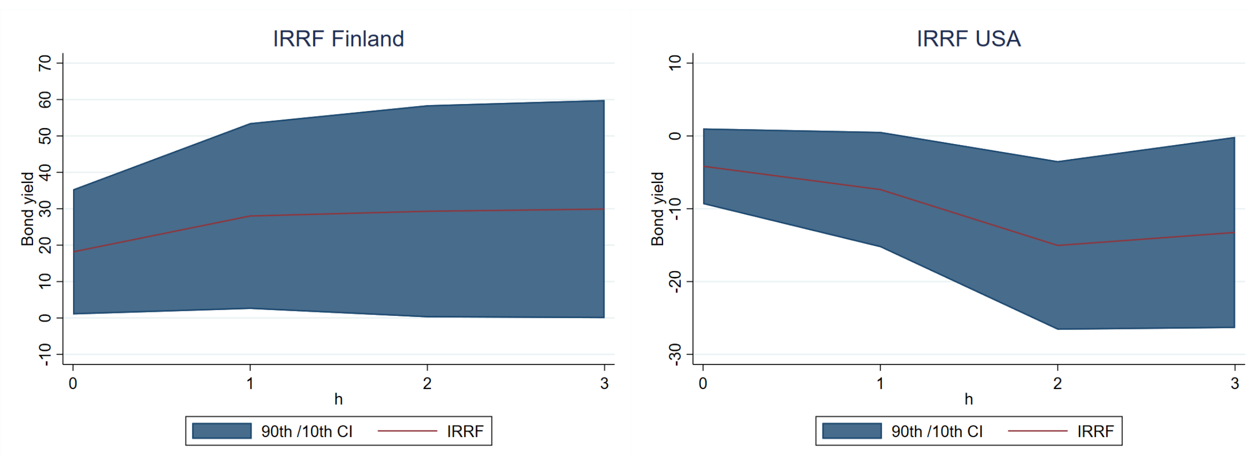

Figure 1

The figure plots impulse response of bond yields to fiscal shocks in basis points (estimated from the country-specific start date through 2007Q4) for Finland (left) and the USA (right). The blue area represents the 90% confidence interval, which we construct using the robust standard error of the estimated $\beta_{i,h}$ in Eq. (1).

For the purpose of our cross-country analysis, we summarize the information in the impulse responses in Figure 1 by examining the average 4-quarter impulse response to government consumption shocks. Let $\beta_{i,h}$ be the horizon h impulse response of interest rates

[7] Very similar results hold if we instead normalize by lagged GDP or use the Baxter and King filter.

[8] Finland and the USA are the least and most unequal countries in our sample, respectively. More details on the measures of income inequality in the next section.

(in annualized basis points). The country-level interest rate response to a 1% (as a share of trend GDP) increase in government spending in country i is computed as:

$$IRRF_i = \frac{1}{4}\sum_{h=0}^{3} \beta_{i,h}. \tag{2}$$

Figure 2 depicts the substantial variation in the IRRF varies across countries. In about half of the countries in the sample (13 countries), the response of interest rates to government consumption shocks is negative. In Switzerland a one percent shock to government expenditure *increases* interest rates by 12.8 basis points (0.128 percentage points) on average over four quarters. In the U.S., a one percent shock to government expenditure *decreases* interest rates by 9.95 basis points (0.0995 percentage points).

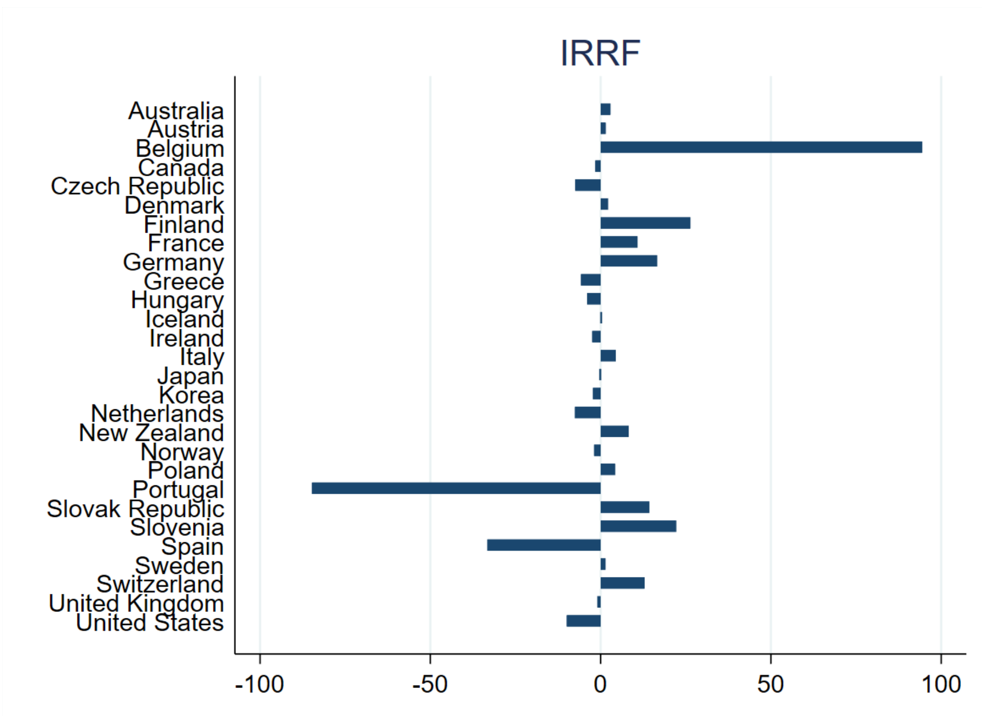

Figure 2

For each country, the figure shows the IRRF (Equation 2) in basis points estimated from the country-specific start date through 2007Q4.

Next we examine the country-level determinants of the IRRF.

2.2 Determinants of the IRRF

Motivated by prior theoretical work (e.g., Eggertsson and Krugman (2012), Brinca et al. (2016)), we examine whether income inequality can account for the variation in the IRRF. We use three measures of inequality: the ratio of the income of the richest 10 percent of the population to the income of the poorest 10 percent (from the OECD); the ratio of the income of the richest 20 percent of the population to the income of the poorest 20 percent (from UNU-WIDER (2021)); and the Gini coefficient of income (from UNU-WIDER (2021)). For each country, we take the average inequality since 1990, when available.[9] Income inequality exhibits substantial cross-sectional dispersion (see Table 5 in our Appendix). The U.S. is the most unequal country of the sample with an average income ratio 90th/10th of 6.2, while Denmark has a ratio of 2.8.[10]

Each country-level IRRF is estimated with different degrees of precision. To account for the variation in the precision of our dependent variable in our regression analysis, we use weighted least squares (WLS), which gives less weight to observations that are estimated with less precision. We define the weight as follows

$$\omega_i = \frac{1}{IRRF_i^{90} - IRRF_i^{10}}, \tag{3}$$

where $IRRF_i^{90}$ and $IRRF_i^{10}$ are the upper (90%) and lower (10%) bounds of the confidence intervals of the IRRF of country i, respectively.[11] WLS provides efficiency gains over OLS and consistent standard errors when all of the error in our regression analysis is attributable to measurement error in the IRRF. When there are additional sources of error (as in the typical case), Lewis and Linzer (2005) show that if the additional error is small relative to the measurement error in the dependent variable, our WLS procedure is similar to feasible generalized least squares that explicitly accounts for both sources of error.

Figure 3 top panel documents the unconditional relationship between the IRRF and inequality. We observe that the IRRF declines with inequality, a surprising pattern given that inequality is often associated with credit constraints (see, for example, Brinca et al. (2016)) that would be expected to cause a higher IRRF. The same relationship holds in the bottom panel of Figure 3 where we drop from the sample the largest (Belgium) and the smallest (Portugal) IRRF from the sample.

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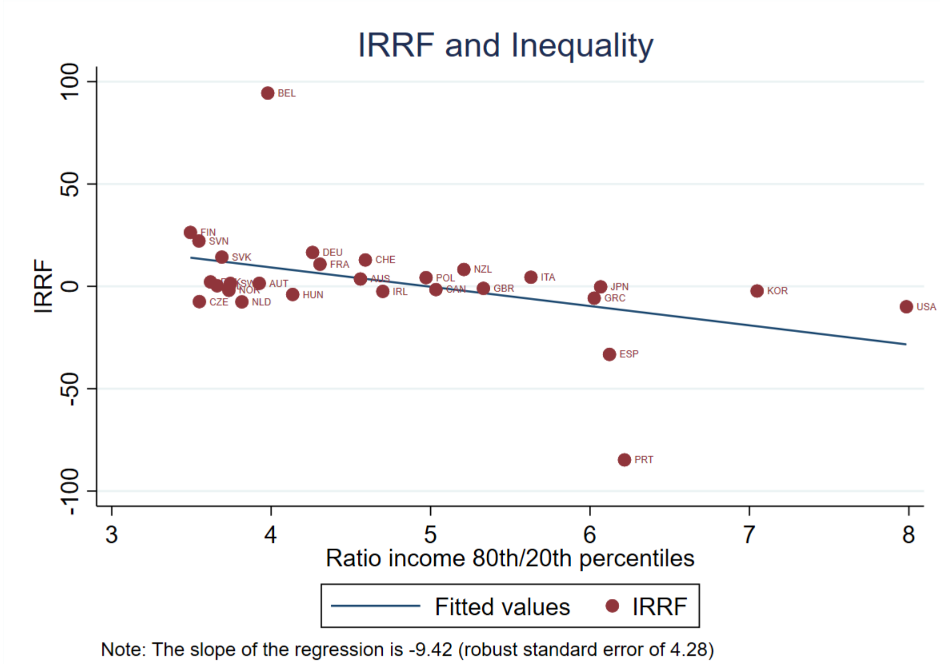
[9] The OECD data is only available from 2001, while the World Income Inequality Database (WIID) is available, for most countries in our sample, since 1990.

[10] Similarly, the U.S. has the largest income ratio 80th/20th (7.98) and the largest Gini coefficient (37.5). Slovenia has the smallest Gini coefficient (24.27), and Finland has the smallest income ratio 80th/20th (3.49).

[11] We compute the confidence interval as follows $IRRF_i^{10} = \frac{1}{4}\sum_{h=0}^{3}\beta_{i,h}^{10}$, where $\beta_i^{10} = \hat{\beta}_i - ttest_{90\%}SD(\hat{\beta}_i)$, and $IRRF_i^{90} = \frac{1}{4}\sum_{h=0}^{3}\beta_{i,h}^{90}$, where $\beta_i^{90} = \hat{\beta}_i + ttest_{90\%}SD(\hat{\beta}_i)$.



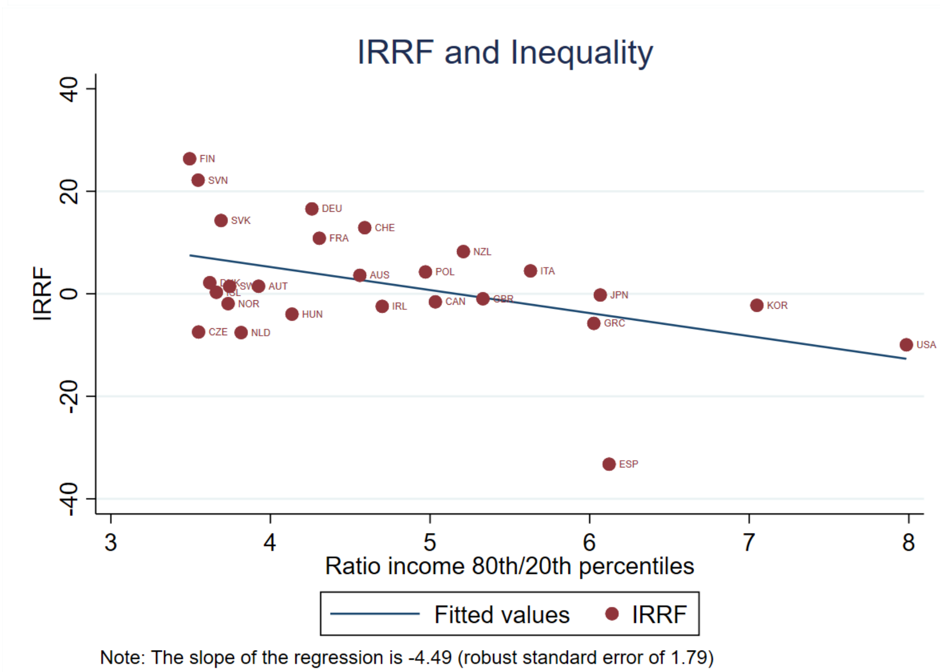


Figure 3

The figure plots $IRRF_i$ (see Equation 2) in basis points (estimated from the country-specific start date through 2007Q4) against the income ratio 80th/20th (from the WIID, average 1990-2007). The top panel includes all the countries, while the bottom panel excludes Portugal and Belgium.

To further isolate the role of inequality from other determinants, we regress the IRRF on measures of economic development (GDP per-capita), financial openness, and government debt to GDP ratio. Our measure of financial openness, from Lane and Milesi-Ferretti (2007), is financial assets plus liabilities, over GDP. The motivation for including this control is that Mundell-Fleming predicts that countries that are more open to international financial markets have smaller or zero responses of interest rates to fiscal shocks.

Table 1 shows the dependence of the IRRF on inequality, conditional on these other determinants. We normalize our covariates by their sample standard deviation. We find that a one standard deviation increase in inequality (income ratio 80th/20th) is associated with a 4.88 basis point decline in the IRRF. The relationship is robust to different measures of income inequality.[12] Similar results hold when we consider data post-2007.

Table 1
IRRF and Inequality

VARIABLES	(1) IRRF	(2) IRRF	(3) IRRF
Income ratio 80th/20th	-4.875**		
	(1.833)		
Income ratio 90th/10th		-4.753**	
		(1.959)	
Income Gini			-4.973**
			(2.028)
Observations	28	28	28
R-squared	0.217	0.206	0.219
Controls	Yes	Yes	Yes

Note: This table presents the WLS coefficients of regressing the estimated IRRF against income inequality (from OECD and WIID databases), GDP per capita (from OECD database), financial openness (from Lane and Milesi-Ferretti (2007)), and government debt to GDP ratio (from OECD database). The regression weights are ω_i (Equation 3). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

While our estimated IRRF from Eq. (1) already controls for the policy rate, it is still possible that, for the full sample of OECD countries, the inverse relationship between inequality and the IRRF is due to monetary policy that is more accommodative of fiscal shocks in un-

[12]The same negative and statistically significant relationship holds when we exclude Portugal and Belgium—the countries with the largest (in absolute value) and least precisely estimated IRRFs—from the sample. Inverse relationships also holds when we control for the fraction of government foreign debt-to-GDP. Priftis and Zimic (2018) and Broner et al. (2018) document a smaller crowding out of investment in economies with higher fraction of government debt abroad. However, we only have 19 observations in this specification as there is no data for Belgium, Denmark, France, Germany, Japan, New Zealand, Norway, and Poland.

equal countries. We directly examine the policy rate response to fiscal stimulus (PRRF).[13] The results in Table 2 show that the same relationship does *not* hold (policy rate responses are independent of inequality), suggesting that government spending relaxes credit markets relatively more in unequal countries, beyond any response of monetary policy to government spending shocks.

Table 2
PRRF and Inequality

VARIABLES	(1) PRRF	(2) PRRF	(3) PRRF
Income ratio 80th/20th	-0.833		
	(2.835)		
Income ratio 90th/10th		-1.554	
		(2.756)	
Income Gini			-0.500
			(2.996)
Observations	28	28	28
R-squared	0.053	0.059	0.052
Controls	Yes	Yes	Yes

Note: This table presents the WLS coefficients of regressing the estimated PRRF against income inequality (from OECD and WIID databases), GDP per capita (from OECD database), financial openness (from Lane and Milesi-Ferretti (2007)), and government debt to GDP ratio (from OECD database). The regression weights are ω_i (Equation 3). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

2.3 Auerbach and Gorodnichenko (2013) shocks

Despite the widespread use of the Blanchard-Perotti approach and the plausibility of its identifying assumptions, there are potential limitations. If changes in government spending are anticipated, the Blanchard-Perotti approach will not capture the exogenous component of government spending (Ramey (2011)). To overcome this challenge, Ramey (2011) uses news about future defense spending to identify fiscal shocks. As Ilzetzki et al. (2013) point

[13]To estimate the PRRF we re-estimate Eq. (1) using the monetary policy rate (or short-term rates when policy rates are not available) as the dependent variable. Long-term bond yields are now part of the control variables in $x_{i,t-l}$.

out, this approach is not viable when estimating fiscal shocks across countries. Data on news about military buildups on which the estimates are based are not available across countries, and even within the U.S. there is little variation in the news measure in the post-war period.

Therefore, as a robustness check, in this section, we identify shocks using semi-annual data on forecast errors for government spending, as in Auerbach and Gorodnichenko (2013). This approach requires information on forecasted government spending, which given its limited availability also limits our data sample. But the advantage of the forecast error approach is that it overcomes concerns that identified innovations to government spending may be anticipated.

Auerbach and Gorodnichenko (2013) identify government spending shocks by regressing one-period-ahead percent forecast errors for government spending from the OECD's "Outlook and Projections Database" in each country on that country's lagged macroeconomic variables (output, government spending, exchange rate, inflation, investment, and imports). The authors also consider a set of country and period fixed effects. The residuals from this regression are innovations in government spending orthogonal to professional forecasts and lags of macroeconomic variables.[14] The sample in this specification is generally shorter than the sample used in the Blanchard and Perotti (2002) specification, since forecasts of government spending are typically only available since the mid-1980s.[15]

We take the estimated unanticipated government spending shocks from Auerbach and Gorodnichenko (2013) and use Jorda (2005)'s local projection method to measure the effect on government bond yields. The data are semi-annual. Therefore, to compare with our 4-quarter IRRF from Section 2.1, we study the effect of government spending innovations over two semesters. In particular, for each country i, we estimate the following regression

$$r_{i,t+h} = \alpha_i + \sum_{l=1}^{L} \psi_{i,h,l} x_{i,t-l} + \beta_{i,h} \hat{g}_{i,t}^{shock} + \mu_{i,t+h}, \tag{4}$$

where $r_{i,t+h}$ is country i's government bond yield at semester $t+h$, $x_{i,t-l}$ controls for monetary policy rate, $\hat{g}_{i,t}^{shock}$ is the Auerbach and Gorodnichenko (2013) semi-annual shock to government spending in country i at semester t (measured in percent), and $\mu_{i,t+h}$ is the error term. We use $L = 2$, two lags (four quarters). Note that here we do not need to control for macroeconomic conditions as they are already accounted for when estimating the Auerbach and Gorodnichenko (2013) shock. We still include the policy rate in $x_{i,t-l}$ to control for the stance of monetary policy.

We estimate impulse responses of interest rates to the fiscal shocks and summarize the information in the impulse responses by examining the average 2-semester impulse response

[14] Note that the government spending series in Auerbach and Gorodnichenko (2013) is the sum of real public consumption expenditure and real government gross capital formation.

[15] See our Data Appendix B for more details on the sample periods available for each approach.

to government spending shocks. Let $\beta_{i,h}$ be the horizon h impulse response of interest rates (in annualized basis points). The country-level interest rate response to a 1% shock to government spending is computed as:

$$IRRF_i = \frac{1}{2}\sum_{h=0}^{1}\beta_{i,h}. \tag{5}$$

Figure 4 also shows significant heterogeneity in the cross-country IRRF. The IRRF is negative in half of the countries in the sample (14 countries). In Switzerland a one percent shock to government expenditure *increases* interest rates by 8.21 basis points on average over four quarters (compared to 12.8 basis points in Section 2.1). In the U.S., a one percent shock to government expenditure *decreases* interest rates by 3.88 basis points (compared to 9.95 basis points in Section 2.1).

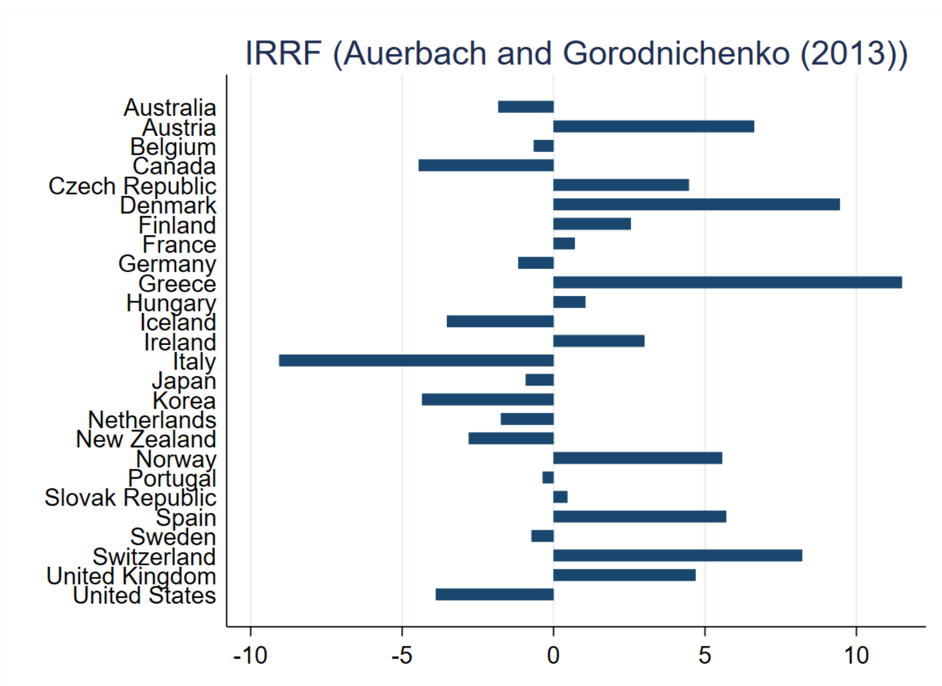


Figure 4
For each country, the figure shows the Auerbach and Gorodnichenko (2013) IRRF (Equation 5) in basis points estimated from the country-specific start date through 2007Q4.

In Figure 5, we show that the inverse relationship between the IRRF and inequality still holds.

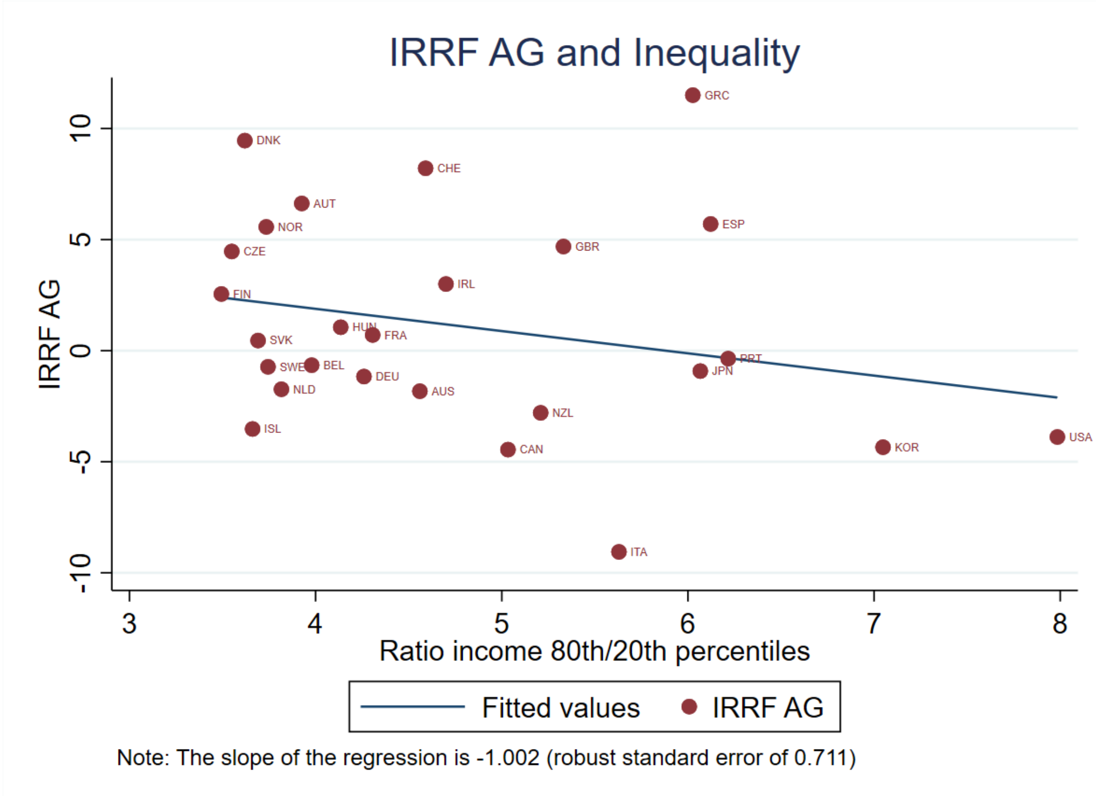


Figure 5

The figure plots $IRRF_i$ (see Equation 5) in basis points (estimated from the country-specific start date through 2007Q4) against income inequality (from the WIID, average 1990-2007).

Table 3 shows that, conditional on other country characteristics, the negative relationship between inequality and the IRRF is statistically significant at the 90% level. A one standard deviation increase in inequality (income ratio 80th/20th) is associated with a 1 basis point decline in the IRRF. In Table 4 we show that the same relationship does not hold between the monetary policy response to fiscal stimulus and inequality.

To summarize our results, the interest rate response to government purchases is heterogeneous across countries and is inversely related to inequality. Below we propose a model in which high inequality is associated with a large fraction of moderately low-income households with high propensities to save (low MPCs). Government consumption redistributes resources to these relatively low-income households and relaxes credit markets.

3 Theory: saving-constrained households, inequality, and interest rates

Here we develop a framework in which the distribution of income is crucially important for the transmission of fiscal policy. To explain our baseline set of facts, we depart from prior

Table 3
IRRF AG and inequality

VARIABLES	(1) IRRF AG	(2) IRRF AG	(3) IRRF AG
Income ratio 80th/20th	-1.389**		
	(0.654)		
Income ratio 90th/10th		-1.598*	
		(0.803)	
Income Gini			-1.319*
			(0.762)
Observations	26	26	26
R-squared	0.147	0.160	0.137
Controls	Yes	Yes	Yes

Note: This table presents the WLS coefficients of regressing the estimated IRRF AG against income inequality (from OECD and WIID databases), GDP per capita (from OECD database), financial openness (from Lane and Milesi-Ferretti (2007)), and government debt to GDP ratio (from OECD database). The regression weights are ω_i (Equation 3). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4
PRRF AG and Inequality

VARIABLES	(1) PRRF AG	(2) PRRF AG	(3) PRRF AG
Income ratio 80th/20th	-1.064		
	(3.756)		
Income ratio 90th/10th		-0.048	
		(4.376)	
Income Gini			-0.590
			(4.335)
Observations	26	26	26
R-squared	0.159	0.157	0.158
Controls	Yes	Yes	Yes

Note: This table presents the WLS coefficients of regressing the estimated PRRF AG against income inequality (from OECD and WIID databases), GDP per capita (from OECD database), financial openness (from Lane and Milesi-Ferretti (2007)), and government debt to GDP ratio (from OECD database). The regression weights are ω_i (Equation 3). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

theoretical work on the relationship between inequality and fiscal effects (e.g., Eggertsson and Krugman (2012)) in that we abstract from credit constraints. We consider an alternative friction that arises from households' need to cover unexpected expenses such as medical bills and automobile repairs. These expenses are costly to avoid. In our baseline model, households have enough access to credit to cover these consumption thresholds. Now debt-burdened, these households use additional income to delever.

Miranda-Pinto et al. (2020) document the importance of unexpected expenditures—or consumption threshold shocks—in matching key features of the microdata.[16] Consumption thresholds build on the notion of "consumption commitments" in Chetty and Szeidl (2007) in that they represent stochastic maintenance costs for aspects of consumption that are costly to reduce in the short-term. In Miranda-Pinto et al. (2020) we demonstrate that many moderately-low-income households that experience a high consumption threshold take on debt to cover the expense and use all additional income to delever. We refer to these households as *saving-constrained* because they borrow more (save less) than they would in the absence of the consumption threshold.

Here we introduce saving-constrained households in a general equilibrium setting. Our objective is to demonstrate in a clear and simple setting the interrelationship between inequality and the IRRF. Therefore, we abstract from the infinite-horizon environment in Miranda-Pinto et al. (2020) and instead consider a two-period setting in which households are subject to a consumption constraint in the first period. This constraint is a reduced-form way of modeling the stochastic consumption thresholds that cause moderately-low-income households to be saving-constrained in Miranda-Pinto et al. (2020).

In the model, higher inequality is associated with more moderately-low-income households who must borrow to meet their consumption threshold in the first period. Government spending redistributes income to low-income, saving-constrained households with low MPCs. This redistribution to low-MPC households relaxes credit markets and puts downward pressure on the equilibrium interest rate, as government wages help poor workers delever. With higher inequality, more households are saving-constrained, and government spending relaxes credits market more (tightens them less).

To accommodate the possibility that interest rates can fall in response to government spending, we examine a setting that permits slack in labor markets.[17] As discussed in Murphy and Walsh (2020), the existence of slack permits a non-positive interest rate response to government spending. In our model, government spending can cause a negative interest rate

[16] Miranda-Pinto et al. (2020) lays out a theory of saving-constrained households and demonstrates that in a dynamic setting with incomplete markets, saving-constrained households exist in the stationary equilibrium (they do not fully precautionarily save to avoid the constraint in a calibrated model). The paper shows that the existence of saving-constrained households provides an explanation for puzzling aspects of the microdata. For example, household-level consumption is as volatile as income but relatively uncorrelated with income. Furthermore, many high-debt/low-wealth households save all additional income (e.g., Sahm et al. (2015), Misra and Surico (2014)) and MPCs tend to increase with income (Kueng (2018) and Lewis et al. (2021)).

[17] The existence of slack in labor markets is consistent with the empirical evidence in Auerbach et al. (2020b).

response in the presence of slack by redistributing income to low-income, saving-constrained households.

3.1 Model

Suppose there are two agent types, rich(r) and non-rich (p). The measure of non-rich agents is $\pi \in [1/2, 1)$, and the measure of rich agents is $1-\pi$. As we will see, π will determine the level of inequality and gross debt in the economy. Each agent elastically supplies up to $\overline{L}$ units of labor in each period, of which there are two: $t \in \{0, 1\}$.

In each period, there is a representative private firm that solves

$$\Pi = \max_{\ell} \left(A\ell^{\alpha} - w\ell \right),$$

where w is the wage, which is stuck at an arbitrary level above the market clearing rate, and $0 < \alpha < 1$. Given w, firm labor demand is $\ell^* = \left(w / (\alpha A) \right)^{1/(\alpha - 1)}$. We assume that (1) $\overline{L} > \ell^*$, (2) the firm randomly hires among the agents, and (3) $A = (w/\alpha)^{\alpha}$ (a simplifying normalization). Therefore, firm and worker optimization imply that $\Pi + w\ell^* = A\ell^{*\alpha} = 1$, that $\ell^* = \alpha/w$, and that each agent's private sector labor income is $w\ell^* = \alpha$, a fraction π of which goes to non-rich agents. Moreover, since $\ell^* < \overline{L}$ there is slack in the labor market in the sense that each agent is willing to supply more labor than the private sector is willing to hire at the stuck wage w.

In $t = 0$, the government also hires the agents (again, randomly across types). Specifically, the government demands $\widetilde{G} = G/w < \overline{L} - \ell^*$ units of labor, which the agents are willing to supply since $\widetilde{G} + \ell^* < \overline{L}$. The government uses the workers to produce government goods and effectively buys these goods from itself. For the purposes of national accounting, these public purchases are valued at their cost. So, $G = \widetilde{G}w = \pi\widetilde{G}w + (1-\pi)\widetilde{G}w$ is both the public wage paid to each agent and the value of government purchases in the national accounts. GDP or national income is, in the two periods,

$$\begin{aligned} Y_0 &= \Pi + w\ell^* + w\widetilde{G} = A\ell^{*\alpha} + G = 1 + G \\ Y_1 &= \Pi + w\ell^* = A\ell^{*\alpha} = 1 \end{aligned} \tag{6}$$

We assume that the rich collectively own half of firm profits. Thus, the total private sector pre-tax income of the rich is $\Pi/2 + (1-\pi)w\ell^*$, while the income of a rich individual is $y^r = \Pi / (2(1-\pi)) + w\ell^*$. Similarly, the private sector pre-tax income of a non-rich individual is $y^p = \Pi / (2\pi) + w\ell^*$, so $(1-\pi)y^r + \pi y^p = 1$. A useful feature of this setup is that a single parameter, π, governs inequality. As π varies between 1/2 and 1, total private income is fixed at $\Pi + w\ell^* = 1$. However, since the poorest 50% of agents are always non-rich, the total private pre-tax income of the richest 50% of agents is

$$\Pi + w\ell^* - \frac{1}{2}\left(\frac{\Pi}{2\pi} + w\ell^*\right),$$

which is monotonically increasing in π. Also, as $\pi \to 1$, half of firm profits are owned by an increasingly small fraction of agents. Furthermore, as $\pi \to 1$, more agents borrow to meet the consumption threshold (by assumption), leading to higher debt.[18]

In the first period, the agents and the government trade zero net supply bonds at gross interest rate R. The government pays for purchases with a flat proportional tax τ on private income in the second period. Since $(1-\pi)y^r + \pi y^p = 1$, the government budget constraint is

$$RG = \tau. \tag{7}$$

The problem of an arbitrary agent of type $i \in \{r, p\}$ is

$$\begin{aligned} &\max_{c_0, c_1} \{\log(c_0) + \log(c_1)\} \;\; \textit{subject to} \\ (i) &: c_0 + \frac{1}{R}c_1 = y^i + \frac{1}{R}y^i(1-\tau) + G \\ (ii) &: c_0 \geq \underline{c}, \end{aligned} \tag{8}$$

where $\underline{c}$ is the consumption threshold. Recall that $G = \widetilde{G}w$ is wage income from government work, and y^i includes both private profits and wages. Since taxes are proportional to private income but government wages are uniform across agents, fiscal policy redistributes from rich to non-rich.

Under the above assumptions, *equilibrium with slack in the labor market* consists of an interest rate R, agent consumption, and taxes τ such that goods markets clear ($\pi\left(c_0^p, c_1^p\right) + (1-\pi)(c_0^r, c_1^r) = (1,1)$), consumption solves the agents' problems (8) given prices and taxes, and the government budget constraint (7) is satisfied ($RG = \tau$).[19] We restrict attention to our case of interest in which equilibrium consumption satisfies $c_0^r > c_0^p = \underline{c}$ (the minimum consumption level binds for the non-rich only), in which rich households are savers and poor households are borrowers.[20] In this *saving-constrained equilibrium*, optimal rich consumption, from combining Euler equation and budget constraint of the rich, is

$$c_0^r = \frac{1}{2}G + \frac{1}{2}y^r\left(1 + \frac{1}{R}(1-\tau)\right),$$

[18] Our model also implies a negative relationship between household debt and the IRRF. Bazillier et al. (2021) show that increases in inequality lead to increases in the ratio of household credit to GDP. Their result is driven by the middle class, rather than the very poor who are more likely to be credit constrained.

[19] The government goods market clears for free since, by assumption, the government consumes whatever it produces. The labor market doesn't clear since each agent is willing to supply $\overline{L}$, while at stuck wage w private and public firms only demand $\ell^* + \widetilde{G} < \overline{L}$ units of labor from each agent.

[20] We discuss the existence of this form of equilibrium in Section 3.2 below.

which after plugging in the government budget constraint (7) becomes

$$c_0^r = \frac{1}{2}(1-y^r)G + \frac{1}{2}y^r\left(1+\frac{1}{R}\right). \tag{9}$$

Finally, imposing market clearing ($\pi c_0^p + (1-\pi)c_0^r = 1$) and $y^r = \Pi/(2(1-\pi)) + w\ell^*$, we get

$$\begin{aligned}\frac{1}{R} &= \frac{2(1-\pi\underline{c})}{\frac{\Pi}{2} + w\ell^*(1-\pi)} - \frac{1-\left(\frac{\Pi}{2(1-\pi)} + w\ell^*\right)}{\frac{\Pi}{2(1-\pi)} + w\ell^*}G - 1 \\ &= \frac{2(1-\pi\underline{c})}{(1-\pi)y^r} - \frac{1-y^r}{y^r}G - 1. \end{aligned} \tag{10}$$

It immediately follows that

$$\frac{\partial^2(1/R)}{\partial G\partial\pi} > 0,$$

implying

Proposition 1 *In a saving-constrained equilibrium with slack in the labor market, the interest rate response to fiscal stimulus falls as inequality rises:* $\frac{\partial^2 R}{\partial G\partial\pi} < 0$.

Proposition 1 says that the impact of G on R is declining in inequality. Government spending redistributes from high MPC to low MPC households, which relaxes credit markets more when the economy is populated by a larger fraction of debt-burdened households. Note, however, that in this stripped-down model increasing government purchases actually unambiguously decreases the interest rate because government spending destroys no resources.[21] However, it is trivial to include government waste by assuming that government consumption/production G requires an input γG of the consumption good, meaning the public budget constraint becomes $G(1+\gamma)R = \tau$. In that case, the sign of $\partial R/\partial G$ may be positive *or* negative but $\partial^2 R/(\partial G\partial\pi) < 0$ still holds provided γ isn't too large. We explore this case in Section 3.2. To summarize, a theory with saving constraints suggests that high inequality is associated with a weaker or even negative response of interest rates to government spending.

Existence: We have shown that the IRRF is declining in inequality in a *saving-constrained equilibrium with slack in the labor market*, but we did not prove this equilibrium exists. However, it is straightforward to show that it does indeed exist when parameters satisfy the following:

$$\frac{\Pi}{4}\left(\frac{2\pi-1}{\pi}\right)G + \frac{\Pi}{2\pi} + w\ell^* \leq \underline{c} < \min\left\{1, \frac{\Pi}{4}\left(\frac{2\pi-1}{\pi}\right)G + \frac{3}{2}\frac{\Pi}{2\pi} + \frac{1+\pi}{2\pi}w\ell^*\right\} \tag{11}$$

First consider the left inequality, which ensures that $c_0^p = \underline{c}$ (at the equilibrium interest rate (10)). Since $\Pi/(2\pi) + w\ell^* < 1$ for $\pi > 1/2$, there exists $\underline{c} \in (0,1)$ satisfying this condition

[21] See Murphy and Walsh (2020) for a formal discussion of why excess capacity (or government spending that does not crowd out private resources) implies that interest rates do not rise in response to government spending.

provided, for example, G is sufficiently small and $\pi > 1/2$. $\underline{c} \leq 1$ is necessary for existence since $c_0^r \geq c_0^p$ and the total private endowment is 1. The right inequality ensures that the expression for the equilibrium interest rate (10) is strictly positive. Since $3/2 > 1$ and $(1+\pi)/(2\pi) \geq 1$, if we can find $\underline{c} \in (0,1)$ satisfying the left inequality, we can find $\underline{c} \in (0,1)$ satisfying the right as well. Note that if (11) holds, market clearing implies $c_0^r > \underline{c}$.

3.2 Numerical example with government waste

We now generalize the model to the case in which government production requires the consumption good (and hence crowds out the private sector) as well as labor. Suppose that one unit of government output requires an input of γ of the consumption good. The government budget constraint (7) becomes $RG(1+\gamma) = \tau$, and the market clearing condition becomes $\pi\left(c_0^p, c_1^p\right) + (1-\pi)\left(c_0^r, c_1^r\right) = (1-\gamma G, 1)$. Figure 6 shows how the *saving-constrained equilibrium with slack in the labor market* changes as we vary inequality (π).[22]

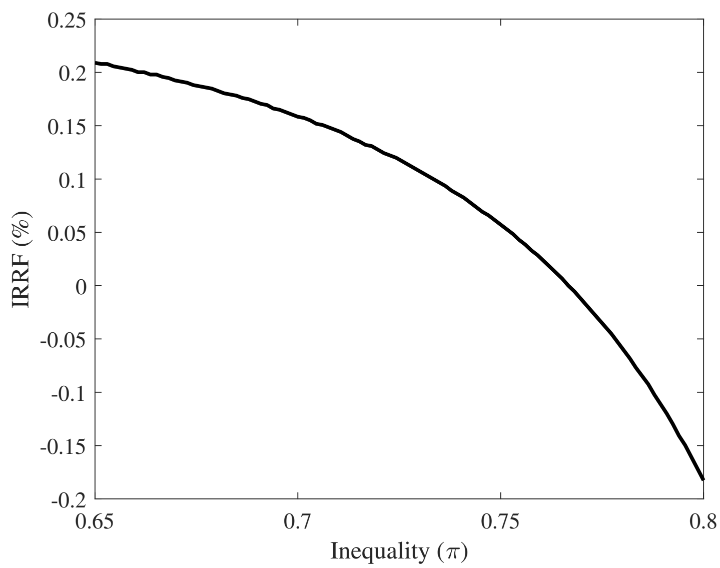


Figure 6

The figure shows how the model's *saving-constrained equilibrium with slack in the labor market*, for the case with government waste $\gamma > 0$, changes as we vary inequality (π). The graph plots the percentage point change in equilibrium R for an increase in G of .02.

Figure 6 plots the IRRF, the percentage point change in equilibrium R for an increase in G of .02 (2% of private output), against π. As in the empirical Figure 3, there is an inverse relationship between inequality and the IRRF, and low (high) inequality is associated with positive (negative) IRRFs.[23]

[22] As an illustrative numerical example, we set $\gamma = .053$, $\alpha = 2/3$, $w = .5$, $G = 0$, $\overline{L} = 5/3$, and $\underline{c} = .95$. With the Section 3.1 normalization $A = (w/\alpha)^\alpha$, we get $\ell^* = 4/3$, $A\ell^{*\alpha} = 1$, $\Pi = 1/3$, and $w\ell^* = 2/3$.

[23] Note, however, that with sufficiently high γ it is possible for the IRRF to increase with inequality. This

3.3 Credit constraints

Here we demonstrate the role of credit conditions for the effect of government spending in the presence of saving-constrained households. In the baseline scenario presented in the previous section, there are no borrowing constraints or debt limits. In this model extension we examine the role of tight credit conditions in the form of debt limits.

Consider a situation in which poor households (borrowers) are subject to a borrowing limit that precludes them from satisfying the minimum consumption level. In particular, suppose that the constraint $c_0 \geq \underline{c}$ is replaced with

$$R\left(y^i + G - c_0\right) \geq \underline{b},$$

which says that the agents can at $t = 0$ promise to pay at most $-\underline{b} \geq 0$ at $t = 1$. If this constraint binds only for the non-rich, we have

$$c_0^p = y^p + G - \frac{1}{R}\underline{b},$$

and then optimal consumption of the rich is

$$c_0^r = \frac{1}{2}(1 - y^r)\,G + \frac{1}{2}y^r\left(1 + \frac{1}{R}\right).$$

Imposing market clearing $(\pi c_0^p + (1-\pi)\,c_0^r = 1)$ and using $y^r = \Pi/\left(2\,(1-\pi)\right) + w\ell^*$, we obtain

$$\frac{1}{R} = \frac{\pi y^p + \left[\pi + (1-\pi)\,\frac{1}{2} - (1-\pi)\,\frac{1}{2}y^r\right]G - 1 + (1-\pi)\,\frac{1}{2}y^r}{\pi \underline{b} - (1-\pi)\,\frac{1}{2}y^r},$$

implying

$$\frac{\partial\,(1/R)}{\partial G} = \frac{\frac{\Pi}{2} + (1-\pi)\,w\ell^* - 1 - \pi}{2\pi\,(-\underline{b}) + (1-\pi)\,w\ell^* + \frac{\Pi}{2}}.$$

is because with $\gamma > 0$, rising inequality has two opposite effects on the IRRF. On one hand, more agents are saving-constrained, and their delevering relaxes credit markets. On the other hand, the interest rate adjusts to induce the rich to consume an amount sufficient to clear markets. With high γ, the second effect dominates, and high rates are needed to get the rich to forgo consumption at $t = 0$. In this case, as inequality rises, there are fewer rich agents, requiring a larger rate increase to clear markets.

Reorganizing and using the fact that $\Pi + w\ell^* = 1$ and that $\pi \in [1/2, 1)$, we obtain

$$\frac{\partial\,(1/R)}{\partial G} = \frac{-\frac{1}{2} + w\ell^*(\frac{1}{2} - \pi) - \pi}{2\pi\,(-\underline{b}) + (1-\pi)\,w\ell^* + \frac{\Pi}{2}} < 0$$

$$\Longrightarrow$$

$$\frac{\partial R}{\partial G} > 0.$$

And, if credit conditions are tight ($-\underline{b}$ is small),

$$\frac{\partial^2\,(1/R)}{\partial G \partial \pi} < 0$$

$$\Longrightarrow$$

$$\frac{\partial^2 R}{\partial G \partial \pi} > 0.$$

Therefore, even in a world with minimum consumption thresholds, if credit conditions become sufficiently tight, non-rich households will become borrowing-constrained (rather than saving-constrained). And in that case, the interest rate rises in response to a G shock, and the effect is amplified by inequality. In other words, the sign of the dependence of the IRRF on inequality is determined by credit conditions: with loose credit, non-rich households face saving-constraints, and the IRRF declines in inequality.

3.4 Discussion

The inverse relationship between the IRRF and inequality in our baseline model is driven by moderate-to-low-income households that primarily save (delever) rather than spend additional income from the government. Government spending transfers resources to these low-income savers, which puts downward pressure on interest rates. The higher is inequality, the more government spending leads to private-sector saving.

This mechanism may at first glance seem counter to prior research that has linked inequality and/or consumer debt with credit constraints and hence high private spending (low private saving) propensities out of government spending (e.g., Brinca et al. (2016), Demyanyk et al. (2019)). However our empirical and theoretical setting differs in important respects from prior research. First, our empirical analysis is conducted on countries with relatively advanced credit markets over a time period of loose credit. Other research has focused on emerging economies with tighter credit conditions (e.g. Brinca et al. (2016)) or on time periods in the U.S. with highly restricted credit (Demyanyk et al. (2019)). Consistent with our empirical setting, our theoretical model focuses on households that can access credit.[24]

[24]Our model abstracts from further dimensions of heterogeneity for simplicity. In a more complicated setting with stochastic minimum consumption thresholds and idiosyncratic income risk, the stationary equi-

If credit conditions were such that low-income households could not borrow to meet their minimum consumption thresholds, then the theoretical relationship between the IRRF and inequality would flip, as we demonstrate in Section 3.3.

More generally, our empirical evidence implies two important underlying mechanisms. First, the fact that the IRRF is negative for half of OECD countries points to the importance of modeling economic slack. In this sense we add to a growing body of evidence documenting that public spending absorbs slack rather than crowding out private production.[25]

Second, the negative relationship between the IRRF and inequality indicates the relevance of models in which inequality is linked to higher aggregate private-sector saving. We propose one such model, but other mechanisms may yield a similar relationship. For example, Brinca et al. (2021) propose that inequality is associated with higher income risk and hence stronger precautionary savings motives.[26] To the best of our knowledge, Nichols and Rehm (2014) develop the more comprehensive measure of aggregate income risk across countries. We use the income risk measure in Nichols and Rehm (2014), only available for 24 out of the 28 countries in our sample, to augment our regression analysis in Section 2.2.[27] The results in Table 6 of our Appendix indicate that precautionary savings can be a complementary mechanism. A one standard deviation in aggregate income risk is associated with an IRRF 3.6 basis points lower. We still observe that, conditional on aggregate income risk, the negative relationship between income inequality and the IRRF is statistically significant and of similar magnitude to that in Section 2.2.[28]

librium features both very poor credit-constrained households (those who hit the borrowing limit) and moderate-to-low-income households who pay off debt on the margin. In a quantitative evaluation of such a model (Miranda-Pinto et al. (2020)), the stationary equilibrium features few of the very poor households and the behavior of saving-constrained households dominates the aggregate private consumption/saving response to income transfers from the government.

[25]See, for example, Auerbach et al. (2020b) and Auerbach et al. (2020c).

[26]Alternatively, Auerbach et al. (2020a) develop a model in which higher inequality implies that a higher share of income ends up with very rich households that have low spending propensities.

[27]Following Nichols (2010), the authors use household survey data for 30 countries and develop an aggregate measure of income risk. The income risk measure is half the squared coefficient of variation of household income measured over time.

[28]The contrast between our model and that in Auerbach et al. (2020a) is informative for deriving aggregate implications from micro behavior. In our model, the higher is inequality the more government spending transfers resources to low-income households who have low MPCs. In Auerbach et al. (2020a), the higher is inequality the more government spending transfers resources to *high*-income households with *low* MPCs. Our view is that neither channel can be favored based on existing evidence from microdata. There is little evidence on how the distribution of government-induced income relates to pre-existing levels of inequality, and even the relationship between MPCs and income or wealth is an open question. Miranda-Pinto et al. (2020) provide a review of the literature on the MPC distribution and conclude that a number of studies document low-wealth or low-income households with relatively low MPCs.

4 Conclusion

We document new cross-county patterns in the effects of government spending on credit markets. First, there is substantial heterogeneity in the interest rate response to fiscal stimulus (IRRF) across OECD countries. Second, the IRRF is negative in approximately half of the countries in our sample. Third, inequality is the strongest determinant of the country-level IRRF, with higher inequality implying a lower (more negative) IRRF.

These facts are difficult to reconcile with existing theory. Government spending is typically associated with a tightening of credit markets, and inequality is often associated with binding credit constraints that would imply even stronger tightening of credit markets in response to government spending.

To help reconcile our facts with theory, we propose a framework that builds on the notion that many middle-to-low-income households use additional income to delever. In this framework, government spending loosens credit conditions more in countries with more middle-to-low-income households (and hence higher inequality). Incorporating slack into the model (such that government spending need not crowd out private consumption) implies that government spending can reduce interest rates.

More generally, our evidence and theory point to important mechanisms that can be further explored using microdata. Our evidence suggests that a complete characterization of consumer-level responses to fiscal stimuli will require conditioning on credit conditions and consumer debt (and their interactions) as well as income.

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A Additional tables and figures

Table 5
Inequality across countries

Inequality measure	Mean	Median	Standard deviation
Income ratio 90th/10th	3.9	3.7	0.79
Income ratio 80th/20th	4.74	4.43	1.18
Income Gini	29.29	29.44	3.81

Note: This table presents the mean, median, and standard deviation of our three average inequality measures across countries. Source: OECD and UNU-WIDER (2021).

Table 6
IRRF, Inequality, and Income risk

	(1)	(2)	(3)
VARIABLES	IRRF	IRRF	IRRF
Income ratio 80th/20th	-3.949**		
	(1.483)		
Income ratio 90th/10th		-3.842**	
		(1.624)	
Income Gini			-4.072**
			(1.829)
Income risk	-4.042**	-3.621*	-3.942*
	(1.918)	(1.888)	(2.037)
Observations	24	24	24
R-squared	0.167	0.158	0.160
Controls	Yes	Yes	Yes

Note: This table presents the WLS coefficients of regressing the estimated IRRF against income inequality and GDP pc (from OECD database), aggregate income risk (from Nichols and Rehm (2014)), financial openness (from Lane and Milesi-Ferretti (2007)), and government debt to GDP ratio (from OECD database). The regression weights are ω_i (Equation 3). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B Data Appendix

This data Appendix describes the data sources used in Section 2. We describe, for each country, the sources, sample, and definition of each time-series variable used in the estimation of government spending shocks as well as cross-sectional variables used in assessing the relationship between the IRRF and country characteristics. Note that the data on inequality (income ratio 80th/10th and Gini) are sourced from Eurostat (22 countries in the sample), National Statistical Agencies (2 countries in the sample), UN (1 country), and OECD (3 countries).

B.1 Australia

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1959-Q3.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1959-Q3.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We obtain quarterly averages of 10-years Australian government bond yields since 1957-Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the Reserve Bank of Australia policy rates since 1969-Q3.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.2 Austria

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1988Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1988Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We obtain quarterly averages of Wtd Avg. of Unredeemed Bonds (%) of Austria's government sine 1971Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the National Bank Discount Rate for the period 1957Q1-1998Q4. Since 1999 we use the European Central Bank (ECB) policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.3 Belgium

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1. From Belgostat we also find quarterly data since 1995. Only annual data is available for a longer time span.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1995Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We obtain data on 5-Year Government Bond Yield to Maturity, Paying 5-8% (%) since 1957Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the Belgium discount rate for the period 1957Q1-1998Q4. Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.4 Canada

GDP: Source: Haver/IMF. We obtain, seasonally adjusted, nominal GDP. We then use the GDP deflator to transform the series to real GDP with base year 2010. We have data available since 1957Q1.

Government consumption: Source: Haver/IMF. Nominal government final consumption expenditure, seasonally adjusted, made real using GDP deflator. We have data available since 1957Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1985S2.

Government bond yields: Source: Haver/IMF. We obtain data on 5-Year Government Bond Yield to Maturity, Paying 5-8% (%) since 1957Q1.

Policy rates: Source: FRED St. Louis Fed Database. We obtain the quarterly averages of the Bank of Canada policy rate since 1957Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.5 Czech Republic

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1996Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1996Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We obtain quarterly data on 5-year government bond yields, which is available since 2000Q2.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the Czech National Bank Discount Rate since 1995Q4.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1993-2011.

B.6 Denmark

GDP: Source: Haver/IMF. We obtain nominal GDP, not seasonally adjusted. We then use the GDP deflator to transform the series to real GDP with base year 2010. We have data available since 1977Q1.

Government consumption: Source: Haver/IMF. Nominal government final consumption expenditure, not seasonally adjusted, is transformed into real using GDP deflator. We have data available since 1977Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We obtain quarterly data on 5-Year government bond yield, which is available since 1960Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rates since 1957Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.7 Finland

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1990Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1990Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We obtain quarterly data on 10-year government bond yield, which is available since 1988Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate for the period 1957-Q1-1998-Q1. After 1999 we use short term money market rates.[29]

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.8 France

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1955Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1955Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1985S2.

Government bond yields: Source: Haver/IMF. We gather quarterly data on 5 or more year government bond yield to maturity, which is available since 1957Q1.

[29]The policy rate from Haver covers the period 1957-1998 and then the years 2004-2005. Ilzetzki et al. (2013) have missing data for the period 1999-2003 and then after 2006 fill with the ECB data. To avoid missing data we use the money market rate of Finland for the period 1999-2007.

Policy rates: Source: Haver/IMF. For the period 1964-1980 we use quarterly averages of short term money market rates. We then obtain the quarterly averages of the central bank policy rate for the period 1981Q1-1998Q4. Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.9 Germany

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1970Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1970Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1985S2.

Government bond yields: Source: Haver/IMF. We gather quarterly data on 3 Years and Over Government and Agency Bond Yield, Wtd Avg, which is available since 1957Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate for the period 1957Q1-1998Q4. Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.10 Greece

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year

2010 (expenditure approach). We have data available since 1970Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1970Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We gather quarterly data on Government Bond Yield: 10-year fixed rate, which is available every quarter since 1992Q4.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate for the period 1957Q1-2000Q4. Since 2001 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.11 Hungary

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1995Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1998S1.

Government bond yields: Source: Haver/IMF. We gather quarterly data on Government Bond Yields since 2001Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate since 1981Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.12 Iceland

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1997Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1997Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 2000S1.

Government bond yields: Source: Haver/IMF. We gather quarterly data on 10 years Government Bond Yields since 1992-Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate since 1964-Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.13 Ireland

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1997Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1997Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We gather quarterly data on 15 years Government Bond Yields since 1964Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate for the period 1957Q1-1998Q4. Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.14 Italy

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1981Q4.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, measured using the expenditure approach in constant prices with base year 2010. We have data available since 1981Q4.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1985S2.

Government bond yields: Source: Haver/IMF. We gather quarterly data on 9-10 years Government Bond Yields since 1958Q1.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate for the period 1964Q1-1998Q4. Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.15 Japan

GDP: Source: Haver/IMF. We obtain nominal GDP data, seasonally adjusted, since 1957Q1. We then convert it to real (base year 2010) using the GDP deflator.

Government consumption: Source: Haver/IMF. We obtain nominal government final consumption expenditure data, seasonally adjusted, since 1957Q1. We then convert it to real (base year 2010) using the GDP deflator.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1985S2.

Government bond yields: Source: Haver/IMF. We gather quarterly data on Yield to maturity of all ordinary Government bond since 1966Q4.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate since 1957Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.16 Korea

GDP: Source: Haver/IMF. We obtain nominal GDP data, not seasonally adjusted, since 1960Q1. We then convert it to real (base year 2010) using the GDP deflator.

Government consumption: Source: Haver/IMF. We obtain nominal government final consumption expenditure data, not seasonally adjusted, since 1960Q1. We then convert it to real (base year 2010) using the GDP deflator.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1997S1.

Government bond yields: Source: Haver/IMF. We gather quarterly data on Government Housing Bond Yield: Weighted Average 1973Q2.

Policy rates: Source: Haver/IMF. We obtain the quarterly averages of the central bank policy rate since 1992Q2.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.17 Netherlands

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1988Q1.

Government consumption: Source: OECD. Real government final consumption expenditure in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1988Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We have data on 10-year government bond yields since1964Q4.

Policy rates: Source: Haver/IMF. We obtain from Haver quarterly averages of the central bank policy rate for the period 1964-Q1-1985-Q2. For the period 1985-Q3-1998-Q4 we use the IFS series 60A (rate on advances) from Iltzetzki, Mendoza, and Vegh (2013). Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.18 New Zealand

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1987Q2.

Government consumption: Source: OECD. Real government final consumption expenditure in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1987Q2.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We have 5+ Year Government Bond Yield to Maturity since 1964Q1.

Policy rates: Source: Haver/IMF. We have central bank policy rates since 1999Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.19 Norway

GDP: Source: Haver/IMF. We gather nominal GDP data, not seasonally adjusted, and then convert it to real using the GDP deflator. We have data available since 1966Q1.

Government consumption: Source: Haver/IMF. We gather nominal government final consumption expenditure data, not seasonally adjusted, and then convert it to real using the GDP deflator. We have data available since 1966Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We have 5+ Year Government Bond Yield to Maturity since 1961Q1.

Policy rates: Source: Haver/IMF. We obtain from Haver quarterly averages of the central bank policy rate for the period 1964Q1-1985Q2. For the period 1985Q3-1998Q4 we use the IFS series 60A (rate on advances) from Ilzetzki et al. (2013). Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.20 Poland

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government consumption: Source: OECD. Real government final consumption expenditure in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: not available.

Government bond yields: Source: Haver/IMF. We have Government Bond Yield since 2001Q1.

Policy rates: Source: Haver. We gather the Poland repo rate since 1998-Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.21 Portugal

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, in constant prices with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We have yields on public debt Instruments subject to withholding Tax since 1957Q1.

Policy rates: Source: Haver/IMF. We obtain from Haver quarterly averages of the central bank policy rate for the period 1957Q1-1998Q4. Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.22 Slovak Republic

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1997-Q1.

Government consumption: Source: OECD. Real government final consumption expenditure in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1997Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 2001S1.

Government bond yields: Source: Haver/IMF. We have Government Bond Yield since 2001Q1.

Policy rates: Source: IFS. We gather central bank discount rates from Ilzetzki, Mendoza, and Vegh (2013) since 1993-Q2.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1993-2011.

B.23 Slovenia

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government consumption: Source: OECD. Real government final consumption expenditure in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: not available.

Government bond yields: Source: Haver/IMF. We have Government Bond Yield since 2002Q2.

Policy rates: Source: Haver/IMF. We gather the central bank rate since 1992Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.24 Spain

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, in constant prices with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We have 2 and more years government bond yields since 1978Q1.

Policy rates: Source: Haver. We gather the bank of spain for the period 1964Q1-1998Q4. Since 1999 we use the ECB policy rates.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.25 Sweden

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1960Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, in constant prices with base year 2010 (expenditure approach). We have data available since 1960Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We have 9 year government bond yields since 1960Q1.

Policy rates: Source: IFS - Ilzetzki et al. (2013). We gather central bank rates data since 1960Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.26 Switzerland

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, in constant prices with base year 2010 (expenditure approach). We have data available since 1995Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1996S2.

Government bond yields: Source: Haver/IMF. We have 5 and over years government bond yield to maturity since 1964Q1.

Policy rates: Source: Haver/IMF. We gather the central bank policy rates since 1964Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.27 United Kingdom

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1955Q1.

Government consumption: Source: OECD. Real government consumption, seasonally adjusted, in constant prices with base year 2010 (expenditure approach). We have data available since 1955Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1985S2.

Government bond yields: Source: Haver/IMF. We have 20 years government bond yield to maturity, issued at par, since 1957Q1.

Policy rates: Source: Haver/IMF. We gather central bank policy rates since 1959Q1.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

B.28 United States

GDP: Source: OECD. Real GDP in constant prices, seasonally adjusted, with base year 2010 (expenditure approach). We have data available since 1955Q1.

Government consumption: Source: OECD. Real government final consumption expenditure, seasonally adjusted, in constant prices with base year 2010 (expenditure approach). We have data available since 1955Q1.

Government spending shock Auerbach and Gorodnichenko (2013): Source: Auerbach and Gorodnichenko (2013). Estimated using professional forecasters data and macroeconomic controls. We have data available since 1985S2.

Government bond yields: Source: Haver/IMF. We have 10 years government bond yield at constant maturity since 1957Q1.

Policy rates: Source: Haver/IMF. We gather central bank policy rates since 1983Q3.

Inequality: Source: OECD. We obtain the ratio of disposable income between the richest 10% of the population to the poorest 10%. Source WIID. We obtain the ratio of disposable income between the richest 20% of the population to the poorest 20%, and the Income gini from disposable income.

Financial openness: Source: Lane and Milesi-Ferretti (2007). We obtain annual data on total external financial assets and total external liabilities. Our measure of country's financial openness is the sum of total assets and liabilities as a ratio of GDP. We take the average between 1990-2011.

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